

MASS STRUCTURE OF AXIAL-VECTOR TYPES OF LEPTONS AND FIELDS

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A classification of currents with respect to C-operation admits the existence of C-noninvariant types of Dirac fermions. Among them one can meet an electroweakly charged C-antisymmetrical leptons, the mass of which includes the electric and weak components responsible for the existence of their anapole charge, charge radius and electric dipole moment. Such connections can constitute the paraleptons of axial-vector currents, for example, at the interactions with field of spinless nuclei of true neutrality. We derive the united equations which relate the structural parts of mass to anapole, charge radius and electric dipole of any truly neutral lepton in the framework of flavour symmetry. Thereby, they establish the C-odd nature of leptons and fields at the level of constancy law of the size implied from the multiplication of a weak mass of C-antisymmetrical lepton by its electric mass. Therefore, all leptons of C-antisymmetricality regardless of the difference in masses of an axial-vector character, have the same anapole with his radius as well as an equal electric dipole. Their analysis together with measured value of an electric dipole moment of lepton gives the right to interpret not only the existence of truly neutral types of leptons and fields but also the availability of mass structure in them as the one of earlier laboratory facts.

1. Introduction

The question about the electric charge of C-noninvariant character is highly important for elucidation of nature of mass of truly neutral fermions. This charge regardless of whether it is hypercharge or anapole [1], may serve as the source of an electric dipole [2].

Such a connection for the first time was established by the author [3] on the basis of flavour dynamics of elementary particles. However, at the unification of the anapole and electric dipole there arises a range of nontrivial problems connected with symmetry properties of these types of currents. The point is that the anapole and electric dipole stating that the same fermion may have simultaneously both T-symmetrical and T-antisymmetrical nature are, respectively, the CP-even and CP-odd components of P-noninvariant axial-vector A_l current. From the point of view of any of particles, the same lepton may not be simultaneously both a C-invariant and a C-noninvariant fermion. A given circumstance becomes more interesting if we take into account that to each type of charge corresponds a kind of the dipole [4]. One of such pairs expresses the CP-invariance as well as the C-noninvariance of an electric dipole. This, however, can explain the absence of T-symmetry of earlier T-invariant anapole even at the violation of CPT-parity of all types of C-antisymmetrical A_l currents [5].

It is not a wonder therefore that a classification of leptonic currents with respect to C-operation admits the existence of C-noninvariant types of leptons ($l^A = e^A, \mu^A, \tau^A, \dots$) possessing an individual flavours [5] which distinguish any of them from others by a true charge. It is characterized by a quantum number conserved at all interactions between C-antisymmetrical ($l^A = C\bar{l}^A$) fermion and field of emission of an axial-vector nature analogously to the fact that lepton flavours or full lepton number are conserved in the processes with well known C-invariant ($l^V = -C\bar{l}^V$) leptons ($l^V = e^V, \mu^V, \tau^V, \dots$) of vector V_l currents [6, 7]. Such a true flavour says in favor of the unidenticality of truly neutral leptons and antileptons from the point of view of CP-symmetricality ($l^A = -CP\bar{l}^A$) of these types of particles.

One can define the structure of their interaction with virtual axial-vector photon [9] in the limit of quantum electrodynamics by the following manner:

$$j_{em}^{A_l} = \bar{u}(p', s')\gamma_5[\gamma_\mu G_{1l^A}(q^2) - i\sigma_{\mu\lambda}q_\lambda G_{2l^A}(q^2)]u(p, s). \quad (1)$$

Here $\sigma_{\mu\lambda} = [\gamma_\mu, \gamma_\lambda]/2$, $l = e, \mu, \tau$, $p(s)$ and $p'(s')$ imply the four-momentum (helicities) of fermion before and after the emission of an axial-vector character, $q = p - p'$ is the momentum transfer.

The anapole and electric dipole form factors G_{il^A} constitute, respectively, the Dirac ($i = 1$) and Pauli ($i = 2$) components of leptonic A_l current [3]. We present their in the form [10]

$$G_{il^A}(q^2) = g_{il^A}(0) + R_{il^A}(q^2) + \dots \quad (2)$$

where $g_{il^A}(0)$ define the static value of the anapole and electric dipole moment of a particle. The functions $R_{il^A}(q^2)$ characterize the lepton axial-vector radius dependence of currents.

The interaction between the anapole r_{l^A} radius and field of emission can be described by the form factor $R_{1l^A}(q^2) = (q^2/6) < r_{l^A}^2 > .$

It is clear, however, that the same anapole may not be both a weak and an electric charge of an axial-vector fermion. At the same time, the nature itself has been created so that to each type of charge corresponds a kind of inertial mass [11]. Therefore, any lepton with an electroweak behavior must have the weak [12] as well as the electric mass. Unlike a C-invariant particle, the mass of which is strictly a vector type, C-noninvariant leptons have the mass of an axial-vector character [3].

Thus, it follows that all the axial-vector mass m_{l^A} and charge e_{l^A} of an electroweakly charged C-antisymmetrical lepton coincide with its electroweak (EW) mass and charge

$$m_{l^A} = m_{l^A}^{EW} = m_{l^A}^E + m_{l^A}^W, \quad (3)$$

$$e_{l^A} = e_{l^A}^{EW} = e_{l^A}^E + e_{l^A}^W \quad (4)$$

including the Coulomb (E) and weak (W) contributions.

They constitute an intralepton harmony of the four types of forces [13] which has the crucial value for steadiness of the anapole charge distribution in lepton of true neutrality. In this appears a latent structure of truly neutral lepton interaction with the Coulomb, weak and the electroweakly interference fields of emission and of a fundamental role in its formation of an axial-vector electroweak mass structural parts.

To show their features, we investigate here the nature of truly neutral types of leptons and fields at the elastic scattering on a spinless nucleus going as

a result of Coulomb (E) and weak (W) masses and of the anapole $g_{1l^A}(0)$ charge, charge r_{l^A} radius and electric dipole $g_{2l^A}(0)$ moment of longitudinal polarized fermions of axial-vector weak neutral A_l currents.

Insofar as the target nucleus is concerned, we will use it as the system of truly neutral types of neutrons and protons [8]. Our reasoning refer to those nuclei and leptons, among which no elementary objects with vector currents.

In the framework of such a presentation, we establish here an explicit mass structure dependence of leptonic currents of true neutrality. Its analysis together with earlier measurements [14] of an electric dipole moment of lepton shows clearly that the existence of axial-vector types of leptons and fields as well as the availability of mass structure in them are by no means excluded experimentally.

2. Unity of lepton axial-vector interaction structural components

An electroweak scattering of leptons by nuclei in the limit of one-boson exchange can be described by the two amplitudes [10]:

$$M_{fi}^E = \frac{4\pi\alpha}{q_E^2} \bar{u}(p'_E, s') \gamma_5 \{ \gamma_\mu [g_{1l^A}^E(0) + \frac{1}{6} q_E^2 < r_{l^A}^2 >_E] - i\sigma_{\mu\lambda} q_{\lambda E} g_{2l^A}^E(0) \} u(p_E, s) < f | J_\mu^\gamma(q_E) | i >, \quad (5)$$

$$M_{fi}^W = -\frac{G_F}{\sqrt{2}} \bar{u}(p'_W, s') \gamma_\mu \gamma_5 g_{A_l}^* u(p_W, s) < f | J_\mu^Z(q_W) | i >. \quad (6)$$

Among them $l^A = l_{L,R}^A(\bar{l}_{R,L}^A)$, $q_E = p_E - p'_E$, $q_W = p_W - p'_W$, $p_E(p_W)$ and $p'_E(p'_W)$ denote the four-momentum of lepton before and after the electric (weak) emission, $g_{il^A}^E$ and $< r_{l^A}^2 >_E$ characterize a latent Coulomb $m_{l^A}^E$ mass dependence of a particle anapole charge, charge radius and electric dipole moment, J_μ^γ and J_μ^Z describe the nuclear currents in the interactions with photon and Z -boson, $g_{A_l}^*$ distinguishes from g_{A_l} , namely, from the constant of leptonic axial-vector weak neutral current by a multiplier $(1/\sin\theta_W)$ arising at $e_{l^A}^E = 1$ and

$$e_{l^A}^E = e_{l^A}^W \sin\theta_W. \quad (7)$$

In the case of exchange by the two bosons of the Coulomb and weak nature, only the mixedly interference (I) interaction

$$Re M_{fi}^E M_{fi}^{*W} = -\frac{4\pi\alpha G_F}{\sqrt{2} q_I^2} Re \Lambda_I \Lambda'_I \gamma_5 \{ \gamma_\mu [g_{1l^A}^I(0) +$$

$$\begin{aligned}
& + \frac{1}{6} q_I^2 < r_{l^A}^2 >_I] - \\
& - i \sigma_{\mu\lambda} q_{\lambda I} g_{2l^A}^I(0) \} \gamma_\mu \gamma_5 g_{A_l}^* J_\mu^\gamma(q_I) J_\mu^Z(q_I)
\end{aligned} \tag{8}$$

is responsible for the investigated process, in which $g_{il^A}^I$ and $< r_{l^A}^2 >_I$ are present as a consequence of compound structure of mass and charge. We have also used the notations

$$\begin{aligned}
q_I &= p_I - p'_I, \\
\Lambda_I &= u(p_I, s) \bar{u}(p_I, s), \\
\Lambda'_I &= u(p'_I, s') \bar{u}(p'_I, s').
\end{aligned}$$

Here p_I and p'_I correspond to the four-momentum of a particle before and after the electroweakly interference scattering.

This presentation can be explained by the fact that a fermion interference (I) mass is not equal to its all (EW) rest mass. A distinction in sizes of both types of masses expresses the unidenticality of a particle mass electric (E) and weak (W) parts. Such a connection, as well as (7), there arises at the unification of electroweak forces at the more fundamental dynamical level.

If choose spinless nuclei of the C-noninvariant nature and longitudinal polarized leptons of true neutrality, the differential cross section of the considered process at the account of (5)-(8) and of the standard definition

$$\frac{d\sigma_{EW}(s, s')}{d\Omega} = \frac{1}{16\pi^2} |M_{fi}^E + M_{fi}^W|^2 \tag{9}$$

can be written in the form

$$\begin{aligned}
d\sigma_{EW}^{A_l}(\theta_{EW}, s, s') &= d\sigma_E^{A_l}(\theta_E, s, s') + \\
&+ d\sigma_I^{A_l}(\theta_I, s, s') + d\sigma_W^{A_l}(\theta_W, s, s')
\end{aligned} \tag{10}$$

where θ_{EW} implies the scattering angle of a studied particle after an electroweakly united (EW) axial-vector emission.

The first cross section here corresponds to the purely Coulomb interaction and is equal to

$$\begin{aligned}
\frac{d\sigma_E^{A_l}(\theta_E, s, s')}{d\Omega} &= \frac{1}{2} \sigma_o^E \{ (1 + ss') [g_{1l^A}^E - \\
&- \frac{2}{3} < r_{l^A}^2 >_E (m_{l^A}^E)^2 \gamma_E^{-1}]^2 +
\end{aligned}$$

$$+ 4(m_{l^A}^E)^2 \eta_E^{-2} (1 - ss') g_{2l^A}^2 t g^2 \frac{\theta_E}{2} \} F_E^2(q_E^2). \quad (11)$$

The second term is explained by the electroweakly mixed interaction (8) and has the form

$$\begin{aligned} \frac{d\sigma_I^{A_l}(\theta_I, s, s')}{d\Omega} &= \frac{1}{2} \rho_I \sigma_o^I g_{A_l} (1 + ss') \{ g_{1l^A}^I - \\ &- \frac{2}{3} < r_{l^A}^2 >_I (m_{l^A}^I)^2 \gamma_I^{-1} \} F_I(q_I^2). \end{aligned} \quad (12)$$

The weak scattering can be described by the cross section

$$\begin{aligned} \frac{d\sigma_W^{A_l}(\theta_W, s, s')}{d\Omega} &= \frac{G_F^2 (m_{l^A}^W)^2}{16\pi^2 \sin^2 \theta_W} g_{A_l}^2 \eta_W^{-2} (1 + ss') [1 - \\ &- \eta_W^2] F_W^2(q_W^2) \cos^2 \frac{\theta_W}{2}. \end{aligned} \quad (13)$$

Here it has been accepted that

$$\begin{aligned} \sigma_o^E &= \frac{\alpha^2}{4(m_{l^A}^E)^2} \frac{\gamma_E^2}{\alpha_E}, \quad \rho_I = -\frac{2G_F(m_{l^A}^I)^2}{\pi\sqrt{2}\alpha \sin \theta_W} \gamma_I^{-1}, \\ \sigma_o^I &= \frac{\alpha^2}{4(m_{l^A}^I)^2} \frac{\gamma_I^2}{\alpha_I}, \quad \alpha_K = \frac{\eta_K^2}{(1 - \eta_K^2) \cos^2(\theta_K/2)}, \\ \gamma_K &= \frac{\eta_K^2}{(1 - \eta_K^2) \sin^2(\theta_K/2)}, \quad \eta_K = \frac{m_{l^A}^K}{E_{l^A}^K}, \\ F_E(q_E^2) &= Z F_c(q_E^2), \quad F_I(q_I^2) = Z Z_W F_c^2(q_I^2), \\ F_W(q_W^2) &= Z_W F_c(q_W^2), \quad q_K^2 = -4(m_{l^A}^K)^2 \gamma_K^{-1}, \\ Z_W &= \frac{1}{2} \{ \beta_A^{(0)} (Z + N) + \beta_A^{(1)} (Z - N) \}, \\ A &= Z + N, \quad M_T = \frac{1}{2} (Z - N), \\ \beta_A^{(0)} &= -2 \sin^2 \theta_W, \quad \beta_A^{(1)} = \frac{1}{2} - 2 \sin^2 \theta_W, \\ g_{A_l} &= -\frac{1}{2}, \quad K = E, I, W. \end{aligned}$$

Of them θ_K characterize the lepton Coulomb, weak and interference scattering angles at the energies

$$E_{l^A}^K = \sqrt{p_K^2 + (m_{l^A}^K)^2},$$

the functions $F_c(q_K^2)$ describe in these three types of processes the charge ($F_c(0) = 1$) form factors of an electroweakly charged C-odd nucleus with the projection M_T of its isospin T , $\beta_A^{(0)}$ and $\beta_A^{(1)}$ denote herewith the isoscalar and isovector component constants of the used nucleus axial-vector weak neutral current.

The cross section of Coulomb scattering consists of the purely self interference parts $(g_{il^A}^E)^2$ and $\langle r_{l^A}^4 \rangle_E$ including as well as the contribution $g_{il^A}^E \langle r_{l^A}^2 \rangle_E$ of the mixed interference between the interactions of the anapole charge and its radius with a nucleus. Such components of the formula (11) can explain the formation of the left - or right-handed [5] dileptons of axial-vector currents:

$$(l_L^A, \bar{l}_R^A), \quad (l_R^A, \bar{l}_L^A). \quad (14)$$

In the presence of the interaction (8), each of these types of paraparticles requires the appearance in (12) of one of its structural parts $g_{A_l} g_{l^A}^I$ or $g_{A_l} \langle r_{l^A}^2 \rangle_I$ and thereby confirms the fact that the structure of difermions is defined by the behavior of their interaction. Therefore, the self interference contributions $g_{A_l}^2$ in (13) can be considered as an indication to the existence of paraleptons of the weak neutral A_l currents.

We have already mentioned that (9) redoubles the mixedly interference cross sections. However, the number of difermions does not distinguish from the number of those processes, in which they can appear. Such a conformity is responsible for separation of any type of the mixedly interference component of the interaction cross section into the two.

By following the structure of formulas (11)-(13), it is easy to observe the terms $(1 + ss')$ and $(1 - ss')$ which say in favor of the scattering with ($s' = s$) or without ($s' = -s$) change of helicities of the left ($s = -1$) - and right ($s = +1$)-handed leptons of true neutrality. Therefore, if we sum each of them over s' , we can present (10) in the form

$$d\sigma_{EW}^{A_l}(\theta_{EW}, s) = d\sigma_E^{A_l}(\theta_E, s) + \frac{1}{2}d\sigma_I^{A_l}(\theta_I, s) +$$

$$+ \frac{1}{2} d\sigma_I^{A_l}(\theta_I, s) + d\sigma_W^{A_l}(\theta_W, s) \quad (15)$$

where the purely Coulomb process cross section has the size

$$\begin{aligned} d\sigma_E^{A_l}(\theta_E, s) = & d\sigma_E^{A_l}(\theta_E, g_{1l^A}^E, s) + \frac{1}{2} d\sigma_E^{A_l}(\theta_E, g_{1l^A}^E, < r_{l^A}^2 >_E, s) + \\ & + \frac{1}{2} d\sigma_E^{A_l}(\theta_E, g_{1l^A}^E, < r_{l^A}^2 >_E, s) + \\ & + d\sigma_E^{A_l}(\theta_E, < r_{l^A}^2 >_E, s) + d\sigma_E^{A_l}(\theta_E, g_{2l^A}^E, s), \end{aligned} \quad (16)$$

$$\frac{d\sigma_E^{A_l}(\theta_E, g_{1l^A}^E, s)}{d\Omega} = \frac{d\sigma_E^{A_l}(\theta_E, g_{1l^A}^E, s' = s)}{d\Omega} = \sigma_o^E (g_{1l^A}^E)^2 F_E^2(q_E^2), \quad (17)$$

$$\begin{aligned} \frac{d\sigma_E^{A_l}(\theta_E, g_{1l^A}^E, < r_{l^A}^2 >_E, s)}{d\Omega} &= \frac{d\sigma_E^{A_l}(\theta_E, g_{1l^A}^E, < r_{l^A}^2 >_E, s' = s)}{d\Omega} = \\ &= -\frac{2}{3} (m_{l^A}^E)^2 \gamma_E^{-1} \sigma_o^E g_{1l^A}^E < r_{l^A}^2 >_E F_E^2(q_E^2), \end{aligned} \quad (18)$$

$$\begin{aligned} \frac{d\sigma_E^{A_l}(\theta_E, < r_{l^A}^2 >_E, s)}{d\Omega} &= \frac{d\sigma_E^{A_l}(\theta_E, < r_{l^A}^2 >_E, s' = s)}{d\Omega} = \\ &= \frac{4}{9} (m_{l^A}^E)^4 \gamma_E^{-2} \sigma_o^E < r_{l^A}^4 >_E F_E^2(q_E^2), \end{aligned} \quad (19)$$

$$\begin{aligned} \frac{d\sigma_E^{A_l}(\theta_E, g_{2l^A}^E, s)}{d\Omega} &= \frac{d\sigma_E^{A_l}(\theta_E, g_{2l^A}^E, s' = -s)}{d\Omega} = \\ &= 4 (m_{l^A}^E)^2 \eta_E^{-2} \sigma_o^E (g_{2l^A}^E)^2 F_E^2(q_E^2) t g^2 \frac{\theta_E}{2}. \end{aligned} \quad (20)$$

The second cross section is responsible for the electroweakly interference scattering and behaves as

$$\begin{aligned} d\sigma_I^{A_l}(\theta_I, s) = & d\sigma_I^{A_l}(\theta_I, g_{A_l}, g_{1l^A}^I, s) + \\ & + d\sigma_I^{A_l}(\theta_I, g_{A_l}, < r_{l^A}^2 >_I, s), \end{aligned} \quad (21)$$

$$\begin{aligned} \frac{d\sigma_I^{A_l}(\theta_I, g_{A_l}, g_{1l^A}^I, s)}{d\Omega} &= \frac{d\sigma_I^{A_l}(\theta_I, g_{A_l}, g_{1l^A}^I, s' = s)}{d\Omega} = \\ &= \rho_I \sigma_o^I g_{A_l} g_{1l^A}^I F_I(q_I^2), \end{aligned} \quad (22)$$

$$\begin{aligned}
\frac{d\sigma_I^{A_l}(\theta_I, g_{A_l}, < r_{l^A}^2 >_I, s)}{d\Omega} &= \frac{d\sigma_I^{A_l}(\theta_I, g_{A_l}, < r_{l^A}^2 >_I, s' = s)}{d\Omega} + \\
&= -\frac{2}{3}(m_{l^A}^I)^2 \gamma_I^{-1} \rho_I \sigma_o^I g_{A_l} < r_{l^A}^2 >_I F_I(q_I^2).
\end{aligned} \tag{23}$$

Third term corresponds to purely weak process and is equal to

$$\begin{aligned}
\frac{d\sigma_W^{A_l}(\theta_W, g_{A_l}, s)}{d\Omega} &= \frac{d\sigma_W^{A_l}(\theta_W, g_{A_l}, s' = s)}{d\Omega} = \\
&= \frac{G_F^2 (m_{l^A}^W)^2}{8\pi^2 \sin^2 \theta_W} g_{A_l}^2 \eta_W^{-2} (1 - \eta_W^2) F_W^2(q_W^2) \cos^2 \frac{\theta_W}{2}.
\end{aligned} \tag{24}$$

If compare (16)-(24), one can see that (18) and (23) have the negative signs. This testifies in favor of coexistence of the anapole g_{1l^A} charge of lepton and its charge r_{l^A} radius. On the other hand, as was noted in the work [3], between g_{1l^A} and g_{2l^A} there exists a hard connection. In such a situation, appears the regularity that at the availability of an axial-vector mass, any of truly neutral leptons can possess simultaneously each of these three types of A_l currents.

It is desirable to also replace (10) after averaging (11)-(13) over s and summing over s' for

$$\begin{aligned}
d\sigma_{EW}^{A_l}(\theta_{EW}) &= d\sigma_E^{A_l}(\theta_E) + \frac{1}{2}d\sigma_I^{A_l}(\theta_I) + \\
&+ \frac{1}{2}d\sigma_I^{A_l}(\theta_I) + d\sigma_W^{A_l}(\theta_W).
\end{aligned} \tag{25}$$

Similarly to the structural parts of (15), any cross section here has the self value:

$$\begin{aligned}
d\sigma_E^{A_l}(\theta_E) &= d\sigma_E^{A_l}(\theta_E, g_{1l^A}^E) + \frac{1}{2}d\sigma_E^{A_l}(\theta_E, g_{1l^A}^E, < r_{l^A}^2 >_E) + \\
&+ \frac{1}{2}d\sigma_E^{A_l}(\theta_E, g_{1l^A}^E, < r_{l^A}^2 >_E) + \\
&+ d\sigma_E^{A_l}(\theta_E, < r_{l^A}^2 >_E) + d\sigma_E^{A_l}(\theta_E, g_{2l^A}^E),
\end{aligned} \tag{26}$$

$$d\sigma_I^{A_l}(\theta_I) = d\sigma_I^{A_l}(\theta_I, g_{A_l}, g_{1l^A}^I) + d\sigma_I^{A_l}(\theta_I, g_{A_l}, < r_{l^A}^2 >_I), \tag{27}$$

$$d\sigma_W^{A_l}(\theta_W) = d\sigma_W^{A_l}(\theta_W, g_{A_l}). \tag{28}$$

Each component of any of them is equal to the corresponding contribution from (16), (21), (24) and that, consequently, there are the ratios

$$d\sigma_E^{A_l}(\theta_E, g_{1l^A}^E) = d\sigma_E^{A_l}(\theta_E, g_{1l^A}^E, s), \quad (29)$$

$$d\sigma_E^{A_l}(\theta_E, g_{1l^A}^E, < r_{l^A}^2 >_E) = d\sigma_E^{A_l}(\theta_E, g_{1l^A}^E, < r_{l^A}^2 >_E, s), \quad (30)$$

$$d\sigma_E^{A_l}(\theta_E, < r_{l^A}^2 >_E) = d\sigma_E^{A_l}(\theta_E, < r_{l^A}^2 >_E, s), \quad (31)$$

$$d\sigma_E^{A_l}(\theta_E, g_{2l^A}^E) = d\sigma_E^{A_l}(\theta_E, g_{2l^A}^E, s), \quad (32)$$

$$d\sigma_I^{A_l}(\theta_I, g_{A_l}, g_{1l^A}^I) = d\sigma_I^{A_l}(\theta_I, g_{A_l}, g_{1l^A}^I, s), \quad (33)$$

$$d\sigma_I^{A_l}(\theta_I, g_{A_l}, < r_{l^A}^2 >_I) = d\sigma_I^{A_l}(\theta_I, g_{A_l}, < r_{l^A}^2 >_I, s), \quad (34)$$

$$d\sigma_W^{A_l}(\theta_W, g_{A_l}) = d\sigma_W^{A_l}(\theta_W, g_{A_l}, s). \quad (35)$$

The above expansions (15) and (25) would seem to say about that either incoming leptons are strictly unpolarized or they have the left (right)-handed longitudinal polarization. One can convince, however, that this is not quite so. The point is that the united structure of medium [15] where a particle interacts with a nucleus can essentially influence on its spin properties. At the same time, the scattering itself becomes possible owing to the unified nature of the anapole and electric dipole. The scattered leptons can therefore be partially ordered class of outgoing fermions.

Thus, (10) constitutes a set of the scattering cross section of partially ordered flux of axial-vector particles

$$d\sigma_{EW}^{A_l} = \{d\sigma_{EW}^{A_l}(\theta_{EW}, s), \quad d\sigma_{EW}^{A_l}(\theta_{EW})\}. \quad (36)$$

It shows that each of (15) and (25) behaves as a subclass:

$$\begin{aligned} d\sigma_{EW}^{A_l}(\theta_{EW}, s) = & \{d\sigma_E^{A_l}(\theta_E, g_{1l^A}^E, s), \quad \frac{1}{2}d\sigma_E^{A_l}(\theta_E, g_{1l^A}^E, < r_{l^A}^2 >_E, s), \\ & \frac{1}{2}d\sigma_E^{A_l}(\theta_E, g_{1l^A}^E, < r_{l^A}^2 >_E, s), \quad d\sigma_E^{A_l}(\theta_E, < r_{l^A}^2 >_E, s), \\ & d\sigma_E^{A_l}(\theta_E, g_{2l^A}^E, s), \quad \frac{1}{2}d\sigma_I^{A_l}(\theta_I, g_{A_l}, g_{1l^A}^I, s), \\ & \frac{1}{2}d\sigma_I^{A_l}(\theta_I, g_{A_l}, g_{1l^A}^I, s), \quad \frac{1}{2}d\sigma_I^{A_l}(\theta_I, g_{A_l}, < r_{l^A}^2 >_I, s), \\ & \frac{1}{2}d\sigma_I^{A_l}(\theta_I, g_{A_l}, < r_{l^A}^2 >_I, s), \quad d\sigma_W^{A_l}(\theta_W, g_{A_l}, s)\}, \end{aligned} \quad (37)$$

$$\begin{aligned}
d\sigma_{EW}^{A_l}(\theta_{EW}) = & \{d\sigma_E^{A_l}(\theta_E, g_{1l^A}^E), \quad \frac{1}{2}d\sigma_E^{A_l}(\theta_E, g_{1l^A}^E, < r_{l^A}^2 >_E), \\
& \frac{1}{2}d\sigma_E^{A_l}(\theta_E, g_{1l^A}^E, < r_{l^A}^2 >_E), \quad d\sigma_E^{A_l}(\theta_E, < r_{l^A}^2 >_E), \\
& d\sigma_E^{A_l}(\theta_E, g_{2l^A}^E), \quad \frac{1}{2}d\sigma_I^{A_l}(\theta_I, g_{A_l}, g_{1l^A}^I), \\
& \frac{1}{2}d\sigma_I^{A_l}(\theta_I, g_{A_l}, g_{1l^A}^I), \quad \frac{1}{2}d\sigma_I^{A_l}(\theta_I, g_{A_l}, < r_{l^A}^2 >_I), \\
& \frac{1}{2}d\sigma_I^{A_l}(\theta_I, g_{A_l}, < r_{l^A}^2 >_I), \quad d\sigma_W^{A_l}(\theta_W, g_{A_l})\}. \tag{38}
\end{aligned}$$

It is seen from (29)-(35) that this subsets have the same size. Such a possibility is realized only if cross sections (15) and (25) are responsible for those processes which can originate as a consequence of formation of the same difermions of an axial-vector nature. In other words, all elements of sets (37) and (38) correspond to one of the above-mentioned types of spin states of paraleptons. In this appears an equality of the investigated process cross section structural parts.

At the same time, it is clear that between the leptons of any of parafermions (14) there exists a flavour symmetrical connection [3]. Such a unification gives the right to interpret the flavour symmetry as a theorem [5] about an equality of the structural components of lepton interaction cross sections with an electroweak field of true neutrality.

3. Connection between leptonic currents of an axial-vector nature

We have already seen that the ratio of each pair of elements in (36) is equal to unity. Such an equality can constitute a set of the forty two relations. They together with sizes of cross sections (29)-(35), establish the system of the twenty one explicit equations.

For elucidation of their ideas, it is desirable to choose the five of them:

$$\frac{d\sigma_E^{A_l}(\theta_E, < r_{l^A}^2 >_E)}{d\sigma_E^{A_l}(\theta_E, g_{1l^A}^E)} = 1, \quad \frac{d\sigma_I^{A_l}(\theta_I, g_{A_l}, g_{1l^A}^I)}{2d\sigma_E^{A_l}(\theta_E, g_{1l^A}^E)} = 1, \tag{39}$$

$$\frac{2d\sigma_W^{A_l}(\theta_W, g_{A_l})}{d\sigma_E^{A_l}(\theta_E, g_{1l^A}^E, < r_{l^A}^2 >_E)} = 1, \quad \frac{d\sigma_I^{A_l}(\theta_I, g_{A_l}, < r_{l^A}^2 >_I)}{d\sigma_I^{A_l}(\theta_I, g_{A_l}, g_{1l^A}^I)} = 1. \tag{40}$$

Insertion of the corresponding values of cross sections from (29)-(35) in (39) and (40) jointly with the limits

$$\lim_{\eta_E \rightarrow 0, \theta_E \rightarrow 0} \frac{tg^2(\theta_E/2)}{\eta_E^2} = \frac{1}{4},$$

$$\lim_{\eta_K \rightarrow 0, \theta_K \rightarrow 0} \frac{\eta_K^2}{(1 - \eta_K^2) \sin^2(\theta_K/2)} = -2$$

leads us once again to the system

$$\frac{1}{3} < r_{lA}^2 >_E (m_{lA}^E)^2 = \pm g_{1lA}^E(0), \quad (41)$$

$$\frac{1}{3} < r_{lA}^2 >_E m_{lA}^E = \pm g_{2lA}^E(0), \quad (42)$$

$$(g_{1lA}^E(0))^2 = g_{A_l} \frac{G_F(m_{lA}^E)^2}{2\pi\sqrt{2}\alpha} \frac{Z_W^*}{\sin \theta_W} g_{1lA}^I(0), \quad (43)$$

$$\frac{1}{3} < r_{lA}^2 >_E g_{1lA}^E(0) = g_{A_l}^2 \frac{G_F^2(m_{lA}^W)^2}{8\pi^2\alpha^2} \left(\frac{Z_W^*}{\sin \theta_W} \right)^2, \quad (44)$$

$$\frac{1}{3} < r_{lA}^2 >_I (m_{lA}^I)^2 = g_{1lA}^I(0). \quad (45)$$

The availability of a multiplier $Z_W^* = Z_W/Z$ in (43) and (44) implies the possible change of the innate sizes of currents g_{ilA}^E , $< r_{lA}^2 >_E$, g_{1lA}^I and $< r_{lA}^2 >_I$ in the result of influence of the target nucleus isotopic structure on these properties of particles [16].

4. Latent structure of axial-vector leptons

At the choice of a nucleus with the same number ($Z = N$) of protons and neutrons, the solution of equations (41)-(45) defines an explicit mass structure dependence of leptonic currents of an axial-vector nature

$$g_{1lA}^E(0) = -g_{A_l} \frac{G_F m_{lA}^E m_{lA}^W}{\pi\sqrt{2}\alpha} \sin \theta_W, \quad (46)$$

$$g_{2lA}^E(0) = -g_{A_l} \frac{G_F m_{lA}^W}{\pi\sqrt{2}\alpha} \sin \theta_W, \quad (47)$$

$$< r_{lA}^2 >_E = -g_{A_l} \frac{3G_F}{\pi\sqrt{2}\alpha} \frac{m_{lA}^W}{m_{lA}^E} \sin \theta_W, \quad (48)$$

$$g_{1l^A}^I(0) = -g_{A_l} \frac{G_F(m_{l^A}^W)^2}{\pi\sqrt{2}\alpha} \sin \theta_W, \quad (49)$$

$$\langle r_{l^A}^2 \rangle_I = -g_{A_l} \frac{3G_F}{\pi\sqrt{2}\alpha} \left(\frac{m_{l^A}^W}{m_{l^A}^I} \right)^2 \sin \theta_W. \quad (50)$$

It is clear, however, that

$$e_{l^A}^E = -g_{A_l} \frac{G_F m_{l^A}^E m_{l^A}^W}{\pi\sqrt{2}\alpha} \sin \theta_W \quad (51)$$

coincides with the renormalized size of C-noninvariant electric charge. In this situation, (46)-(50) can be expressed in a latent united form

$$g_{1l^A}^E(0) = e_{l^A}^E, \quad (52)$$

$$g_{2l^A}^E(0) = \frac{e_{l^A}^E}{m_{l^A}^E}, \quad (53)$$

$$\langle r_{l^A}^2 \rangle_E = \frac{3e_{l^A}^E}{(m_{l^A}^E)^2}, \quad (54)$$

$$g_{1l^A}^I(0) = \frac{m_{l^A}^W}{m_{l^A}^E} e_{l^A}^E, \quad (55)$$

$$\langle r_{l^A}^2 \rangle_I = \frac{m_{l^A}^E m_{l^A}^W}{(m_{l^A}^I)^2} \langle r_{l^A}^2 \rangle_E. \quad (56)$$

They show that $g_{2l^A}^E$ corresponds to a Dirac value of the electric dipole. Insofar as its anomalous component is concerned, it can essentially appear at the exchange by the two bosons.

5. Conclusion

Already known laboratory facts [14] for the lepton electric dipole moment give the following estimates:

$$d_{e^A}^E = 0.07 \cdot 10^{-26} \text{ e} \cdot \text{cm}, \quad (57)$$

$$d_{\mu^A}^E = 3.7 \cdot 10^{-19} \text{ e} \cdot \text{cm}, \quad (58)$$

$$d_{\tau^A}^E = 0.45 \cdot 10^{-16} \text{ e} \cdot \text{cm}. \quad (59)$$

In establishing these sizes, it has been usually assumed that e is equal to an electric e_{lV}^E charge of lepton of a vector nature. If we accept this idea, comparing (53) with (57)-(59), we would define the other values of C-invariant lepton masses instead of the available data [14] in the literature. They satisfy the inequalities

$$e_{lA}^K \neq e_{lV}^K, \quad m_{lA}^K \neq m_{lV}^K \quad (60)$$

which follow from the fact that usual Dirac fermions having the mass of a vector character [3] possess no an axial-vector interaction [5].

Turning to (52) and (53), we remark that

$$\frac{g_{1lA}^E(0)}{g_{2lA}^E(0)} = m_{lA}^E. \quad (61)$$

It is compatible with that take places at the availability of the same electric charge of an axial-vector character in all types of C-noninvariant leptons.

Another serious basis for such a statement is that flavour symmetry expresses the lepton universality [8]. This principle is a general and does not depend of whether the fermions have a vector or an axial-vector interaction. Thereby, it requires the establishment of nature of truly neutral types of leptons and fields from the point of view of constancy law of the size

$$m_{lA}^E m_{lA}^W = \text{const.} \quad (62)$$

According to one of its aspects, all C-noninvariant leptons regardless of the difference in masses of an axial-vector character, possess an equal anapole charge with his radius as well as an identical electric dipole moment.

From our earlier developments [17], we find that the standard formula for e_{lV}^E with the use of a relation

$$\frac{G_F}{\pi\sqrt{2}\alpha} = \frac{1}{2m_W^2} \frac{1}{\sin^2 \theta_W} \quad (63)$$

can be presented as

$$e_{lV}^E = -g_V \frac{m_{lV}^E m_{lV}^W}{2m_{W\pm}^2} \frac{1}{\sin \theta_W}. \quad (64)$$

The latter would seem to indicate that (63) gives the possibility to express the size of (46) through the charge of C-invariant lepton. On the other hand, such a unification of (46), (47) and (64) together with (57)-(59) allows to

establish those values of the weak axial-vector masses, at which all predictions of the universality law (62) say in favor of that truly neutral leptons due to their C-noninvariant nature possess no interaction with W^\pm -bosons. They have with W^0 -bosons the same interactions as the nucleons of an axial-vector character.

We can, therefore, reduce (51) to the following:

$$e_{lA}^E = -g_{A_l} \frac{m_{lA}^E m_{lA}^W}{2m_{W^0}^2} \frac{1}{\sin \theta_W}. \quad (65)$$

This can be based on the fact that C-even or C-odd fermion constitutes, respectively, a vector or an axial-vector gauge boson.

Thus, we have established a part of nature of elementary particles in which there exist the massive $Z^\pm(W^0)$ -bosons. From their point of view, the interaction between the C-symmetrical (C-antisymmetrical) lepton and field of emission there arises at the expense of exchange not only by vector (axial-vector) photon but also by $Z^\pm(Z^0)$ -boson. Herewith a group is obtained of arguments in favor of the unidenticality of masses

$$m_{Z^0} \neq m_{Z^\pm}, \quad (66)$$

$$m_{W^0} \neq m_{W^\pm} \quad (67)$$

which in conformity with the ideas [18] of the standard electroweak theory state that

$$m_{W^0} = m_{Z^0} \cos \theta_W. \quad (68)$$

$$m_{W^\pm} = m_{Z^\pm} \cos \theta_W. \quad (69)$$

So, we must recognize that all earlier measured properties of gauge bosons $Z(W)$ can be interpreted as those features of fields which refer undoubtedly only to $Z^\pm(W^\pm)$ -bosons. Their nature has been created so that to any type of a vector particle $Z^\pm(W^\pm)$ corresponds a kind of axial-vector $Z^0(W^0)$ -boson. They constitute herewith the triplets (Z^-, Z^0, Z^+) and (W^-, W^0, W^+) as a consequence of a connection between the masses of each of them.

However, in spite of that the above-mentioned triboson unification needs in special verification, a system of inequalities of (60), (66) and (67) gives the possibility to understand not only the existence of truly neutral types of Dirac fermions and gauge fields but also the availability of mass structure in them as the one of experimentally known facts.

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